IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

UTILITY PATENT APPLICATION TRANSMITTAL LETTER

Atty./Agent Docket No.: __CE08291R__

Mailing Date: __March 13, 2000__

Express Mail Label No.: __EJ923752127US__

To: Assistant Commissioner for Patents
Box Patent Application
Washington, D.C. 20231

Dear Sir:

Transmitted herewith for filing under 37 CFR 1.53 (b) is a Nonprovisional Utility Patent:

___X___ New Application; or a _____ Continuation, _____ Division, or _____ Continuation-in-Part (CIP)
Application of prior US application No. _____/_____, filed on _____, having US
Examiner _____, in Group Art Unit_____: of

Inventor(s):   Mark D. Hetherington
                 Lee M. Proctor
                 Nai Sum Wong
                 John M. Harris

For (Title):   Method and Apparatus for Checking Communicated Data

This transmittal letter has 2___ total pages.

Enclosed are:

___X___   _2___ sheets of informal drawings, along with _15___ pages of specification and claims,

___X___   Oath or Declaration Combined with Power of Attorney (_4__ pages)
___X___   Newly Executed (original or copy)
_____   Copy from a prior application (if this is a Continuation/Division with no new matter)
_____   Statement deleting named inventor(s) in prior application if this is a
              Continuation/Division (See 37 CFR 1.63(d)(2) and 1.33(b).)
_____   Consider as the above Statement, Please delete as inventors for this application
              the following inventors named in the prior application: _____.

_____   A certified copy of a _____ (non-US) application
          S/N _____/_____, having a filing date of _____, and foreign
priority to
          this non-US application for the present application is hereby claimed under 35 USC 119.

___X___   An Assignment Transmittal Letter and Assignment of the invention to MOTOROLA, INC.

_____   An Information Disclosure Statement (IDS), with _____ PTO-1449, and
          _____ citation copies.

_____   Preliminary Amendment

___X___   Print EFS

___X___   Return Receipt Postcard

_____   Petition For Extension of Time for parent application of the present Continuation/Division/CIP
          application

Instructions:

_____ Incorporation by Reference (for Continuation/Division application) The entire disclosure of the prior application, from which a copy of the oath or declaration is supplied, is considered as being part of the disclosure of the accompanying application and is hereby incorporated by reference therein.

_____ Since the present application is based on a prior US application, please amend the specification by adding the following sentence before the first sentence of the specification: "The present application is based on prior US application No. _____ / _____, filed on_____, which is hereby incorporated by reference, and priority thereto for common subject matter is hereby claimed."

_____ Please cancel filed claims ___·_____.

__X__ The filing fee is calculated as follows:

CLAIMS AS FILED, LESS ANY CANCELED BY AMENDMENT

	NUMBER OF CLAIMS	NUMBER EXTRA	RATE	FEE
TOTAL CLAIMS	19 - 20 =	0	X $18	= $.00
INDEPENDENT CLAIMS	4 - 3 =	0	X $78	= $78.00
MULTIPLE DEPENDENT CLAIMS		$270		= $.00
			BASIC FEE	= $ 690.00
			TOTAL FILING FEE	= $768.00

__X__ Please charge Deposit Account No. 13-4772 in the amount of $ 768.00 for the Total Filing Fee. Two duplicate copies of this sheet are enclosed.

__X__ The Commissioner is hereby authorized to charge any additional fees which may be required now or in the future under 37 CFR 1.16 or 37 CFR 1.17, including any present or future time extension fees which may be required, or credit any overpayment to Deposit Account No. 13-4772. Two duplicate copies of this sheet are enclosed.

Date: 3 | 13 | 00

Signature: _____

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I hereby certify that this paper or fee is being deposited with the United States Postal Services "Express Mail Post Office to Addressee" service under 37 CFR §1 10 on the date indicated above and is addressed to the Commissioner of Patents & Trademarks, Washington, D C 20231

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Rev. 3/30/98.phm   **UTILITY PATENT APPLICATION TRANSMITTAL LETTER**   PAGE 2 OF 2

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APPLICATION INFORMATION

Title Line One:: Method and Apparatus for Checking Commun
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Formal Drawings?:: No
Application Type:: Utility
Docket Number:: CE08291R
Secrecy Order in Parent Appl.?:: No

Source::   PrintEFS Version 1.0.1

METHOD AND APPARATUS FOR CHECKING COMMUNICATED DATA

Field of the Invention

5   The present invention relates generally to
communication systems, and more particularly, the
present invention relates to a method and apparatus
for checking radio link protocol (RLP) data within a
communication system.

Background of the Invention

10   Within a Code Division Multiple Access (CDMA),
and other communication system types, communicated
information, either voice or data, is carried
between communication resources, e.g., a
15   radiotelephone and a base station, on a
communication channel. Within broadband, spread
spectrum communication systems, such as CDMA based
communication systems in accordance with Interim
Standard IS-95B, a spreading code is used to define
20   the communication channel.
       In addition to a primary channel, the
communication channel may also include one or more
secondary channels. The secondary channels provide
an ability to increase bandwidth by permitting
25   transmission of information within these secondary
channels during transmission of data, e.g., coded
voice or data, within the primary channel. The
primary channel is used to carry, either at a full
transmission rate or some sub-rate, data such as
30   coded voice or data. When not carrying data, the
primary channel carries an idle data pattern.

The secondary channels may carry virtually any form of data, including what is referred to as RLP data. However, the secondary channels do not always carry data. For example, according to the IS-95B

5   standard for high-speed data services over CDMA cellular systems, a given call may concatenate up to 7 supplemental channels with the fundamental channel to transmit high bandwidth data. The supplemental channels are required by IS-95B to either transmit

10   at full rate or to mute the transmitter. The problem is that when the supplemental channels are muted, the receiver has no way of knowing this and the receiver attempts to decode the air signals as if a full rate frame was sent. Muting the

15   transmitter results in a random data pattern, and it is this random data pattern that the receiver attempts to decode. The frame CRC is intended to screen these decoded random data frames; however, the IS-95B frame CRC is only 12-bits. This means

20   for random data, the frame CRC will pass a frame as valid on average once every 4096 muted frames.

Interim Standard IS-707A specifies the transmission of RLP data, but provides very little error checking of data frames received. When

25   corrupt data frames are received by the RLP layer after falsely passing the frame CRC, the typical result is a reset of the RLP layer. This causes data loss and requests for retransmission by higher layer protocols. When the RLP layer receives the

30   corrupt data frame, it will detect missing data frames from the currently expected sequence number

up to the sequence number of the corrupt data frame
and will request retransmission of these data frames
from the peer RLP layer. Since the frames detected
as missing by one RLP layer were never really sent

5   by the peer RLP layer, the peer RLP layer cannot
comply with the request. According to the IS-707A
standard, the RLP layers need to resynchronize via
the RLP reset procedure. In most cases, this will
result in data loss to the higher layers, which

10 produces the overall effect of degraded bandwidth.
This can also affect triggering of the dormant timer
for packet data since the retransmission requests
and the RLP reset procedure appear as activity and
reset the timer. Timer reset can cause calls that

15 are effectively idle, to remain active and consume
resources.
        Thus, there is a need for a method and
apparatus for providing RLP data checking in a
communication system.

20

Brief Description of the Drawings

        FIG. 1 is a block diagram of a supplemental
band processing apparatus incorporating an RLP data

25 checking stage in accordance with a preferred
embodiment of the invention.
        FIG. 2 is a block diagram illustrating an
apparatus for providing RLP data checking in
accordance with a preferred embodiment of the

30 invention.

FIG. 3 is a block diagram illustration of the frame serialization function illustrated in the block diagram of FIG. 2.

FIG. 4 is a flow chart illustrating a method of
5   RLP data checking in accordance with a preferred embodiment of the invention.

Detailed Description of the Preferred Embodiments

10   An apparatus and method provide RLP data checking. In accordance with preferred embodiments of the invention, an apparatus includes a frame serialization stage and a bad frame filter that detects possible bad frames and reclassifies these
15   bad frames as erasures. In this manner, bad frame data are not passed to the RLP layer, and unnecessary resetting and resynchronization steps are avoided.

With reference to FIG. 1, a data processing
20   apparatus 10 includes a symbol quality assessment stage 12, a frame CRC stage 14 and a RLP data layer 16. The symbol quality assessment stage 12 evaluates data frames utilizing a weighting procedure to ensure that no more than a
25   predetermined percent of the bad frames are passed on to the CRC stage 14. To overcome problems associated with passing random frames from the CRC stage 14, it is possible to adjust the threshold of the symbol quality assessment stage 12. However,
30   such an adjustment would necessarily result in rejecting a higher percentage of good frames.

Rejecting good frames requires higher layer activity
to request retransmission of these frames. Thus,
adjusting the symbol quality assessment stage 12 is
not a viable solution to the problem of passing bad

5   frames to the RLP layer 16. Therefore, to overcome
the problem of passing bad frames to the RLP data
layer 16, disposed between the CRC stage 14 and the
RLP data layer 16 is a pre-RLP data checking stage
18.

10   FIG. 2 illustrates the pre-RLP data checking
stage 18, which, as can be seen from FIG. 2,
includes a frame serialization stage 20 and a bad
frame filter stage 22. The frame serialization
stage 20 receives RLP frames from the IS-95 layer,

15   and serializes them according to the frame sequence
number associated with each frame.

        The process of frame serialization is
illustrated in FIG. 3, wherein a plurality of frames
having sequence numbers 24 are received by the frame

20   serialization stage 20. The frame serialization
stage further receives expected sequence number
data, V(R), from the RLP layer. An output of the
frame serialization stage 20 is a serialized
sequence of frames 26. In the example illustrated

25   in FIG. 3, the expected sequence number, V(R) is 11,
the received frames are numbered 12, 13, 15, 16 and
99 along with an erasure frame 28 and an invalid
frame 30. The frame serialization stage 20 is
operable to insert a place holding frame "X" in

30   place of potentially missing frames. Thus, the
serialized frame sequence 32 is shown in FIG. 3 as

"X 12 13 X 15 16 99" where "Xs" have been inserted
for the apparently missing frames 11 and 14. Once
the sequence has been serialized, the sequenced
frames may be filtered by the bad frame filter stage

5   22. In accordance with a preferred embodiment of
the invention, the frame bearing sequence number
"99" would be reclassified as an erasure because it
is substantially out of sequence in comparison with
the expected sequence number and the maximum number

10   of frames that could be received within a particular
time slot.

        A process 400 for filtering used by the bad
frame filter stage 22 is illustrated in the flow
chart of FIG. 4.   A feature of the bad frame filter

15   stage 22 is the reclassification of suspected bad
frame data as erasures. Erasures are recognized by
the RLP layer, and do not cause initiation of reset
procedures. The process 400 starts at step 402 and
a consecutive erasure/invalid counter, C_i, and a

20   consecutive serial erasure counter, C_s, are reset.
For each frame received, step 406, the process first
determines whether the frame is a new RLP data frame
or not, step 408. RLP control frames and
retransmitted data frames are not filtered by the

25   process since RLP already protects against errors
for these types of frames. For the purposes of this
process, these frame types are treated as
erasure/invalid frames and the consecutive erasure
counters are incremented, step 422.

30   If the received frame is a new data frame, the
consecutive erasure counter for the given channel is

compared against a threshold value, step 410, to
determine whether the frame is eligible for being
discarded. If it is, then the frame sequence number
of the received frame is compared with the next

5   expected sequence number $V_s(R)$, step 412, and to the
number of consecutive erasures from the serialized
frame sequence 32, step 414, to determine whether
the frame is valid or not. If the frame is
considered to have an invalid sequence number, the

10 consecutive reclassification counter is incremented,
step 416, and compared to a threshold, step 418. If
the threshold has not been exceeded, the frame is
discarded, step 420, and the consecutive erasure
counters are updated, step 422. Otherwise the frame

15 is considered valid since it is possible that the
frame was received within the elapsed time. In this
case, the consecutive reclassification frames
counter Cn is reset, step 424, $V_s(R)$ is updated to be
one greater than the valid sequence number, steps

20 426 and 428 and the counters Ci and Cs are reset.
It should be noted that $V_s(R)$ is reinitialized to
V(R) (from the RLP layer) at the beginning of each
20 millisecond (ms) frame block.

        The proposed process has been designed with

25 several configurable parameters to alter its
behavior. The consecutive channel erasure threshold
(T_i) may be used to prevent reclassification when a
given channel is transmitting on most of its
timeslots. The consecutive reclassification

30 threshold is designed to protect the algorithm in
the event that a gap in RLP sequence number does

develop without the appropriate amount of elapsed time. The sequence number guard pad allows the algorithm to allow some small deviations in sequencing before declaring the frame invalid and

5   forcing reclassification.

The process described could also be expanded to delay decisions on frame reclassification until the next set of frames has arrived. This would introduce some delay in the process; however,

10   information regarding further sequence numbers may strengthen the algorithm and reduce the probability of bad decisions. For example, if a group of frames appear substantially out of sequence, it may be because one or more data packet(s) has/have been

15   delayed. The next sequence of frames may reveal that an otherwise out of sequence frame, is the correct next frame.

The invention has been described in terms of several preferred embodiments. These preferred

20   embodiments are meant to be illustrative of the invention, and not limiting of its broad scope, which is set forth in the following claims. For example, the invention may find application in systems designed in accordance with the IS-95A

25   single variable rate channel structure or in accordance with the IS-95C channel structure, or in any radio-frequency environment where RLP is utilized. One of ordinary skill in the art will appreciate that the invention will benefit virtually

30   any communication system where discontinuous transmission (DTX) is utilized as such system will

be susceptible to passing with some probability random data as valid data. In accordance with the invention, and in such system, suspect omitted are detected and place holder frames inserted and/or

5   suspect bad data frames are detected and reclassified, for example, as erasure frames, before being passed to the data detector.

CLAIMS

1.   Within a communication system providing communication services on a communication channel, a method of correcting information communicated on the communication channel comprising the steps of:

receiving on the communication channel a plurality of data frames, wherein the plurality of data frames include at least one of valid data frames, erasure data frames and invalid data frames and wherein each valid data frame comprises an associated data frame sequence identifier;

sequencing the plurality of data frames according to the data frame sequence identifiers to form a data frame sequence;

identifying within the data frame sequence an omitted data frame;

inserting within the data frame sequence a place holder frame for the omitted data frame;

determining a valid frame sequence parameter;

validating the data frame sequence using the valid frame sequence parameter.

2.   The method of claim 1, further comprising the step of modifying the data frame sequence responsive to the data frame sequence parameter.

3.   The method of claim 1, further comprising the step of characterizing received valid data frames as invalid data frames responsive to the data frame sequence parameter.

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4.   The method of claim 1, further comprising,
before the step of validating the data frame
sequence, the step of receiving a next data frame
5   sequence.

5.   A method of providing RLP data checking
comprising:
        receiving a plurality of RLP data frames;
10   sequencing the plurality of RLP data frames
according to data frame sequence identifiers to form
a data frame sequence;
        identifying within the data frame sequence an
omitted data frame;
15   inserting within the data frame sequence a
place holder frame for the omitted data frame;
        determining a valid frame sequence parameter;
        validating the data frame sequence using the
valid frame sequence parameter.
20

6.   The method of claim 5, further comprising the
step of modifying the data frame sequence responsive
to the data frame sequence parameter.

25   7.   The method of claim 5, further comprising the
step of characterizing received valid data frames as
invalid data frames responsive to the data frame
sequence parameter.

8.   The method of claim 5, further comprising,
before the step of validating the data frame
sequence, the step of receiving a next data frame
sequence.

5

9.   A method of providing RLP data checking
comprising:
        receiving a plurality of RLP data frames;
        identifying from the RLP data frames a suspect
10   frame, reclassifying the suspect frame to form
        a reclassified frame, and
        passing the reclassified frame to a RLP data
detector.

15   10.   The method of claim 9, wherein the step of
reclassifying the suspect frame comprises
reclassifying the bad frame as an erasure.

11.   The method of claim 10, wherein the step of
20   reclassifying the suspect frame comprises inserting
a place holder frame.

12.   The method of claim 10, wherein the step of
reclassifying the suspect frame comprises
25   characterizing received a valid data frame as an
invalid data frame responsive to a data frame
sequence parameter.

13.   The method of claim 10, further comprising the
step of sequencing the plurality of RLP data frames
according to data frame sequence identifiers to form
a data frame sequence.

5

14.   The method of claim 13, further comprising the
step of modifying the data frame sequence responsive
to a data frame sequence parameter.

10   15.   The method of claim 10, further comprising the
step of validating the data frame sequence.

16.   The method of claim 15, further comprising,
before the validating the data frame sequence, the
15   step of receiving a next data frame sequence.

17.   An apparatus for RLP data checking comprising:

a frame serialization stage, the frame serialization stage coupled to receive a plurality of RLP data frames, each of the plurality of RLP

5   data frames having a sequence number and the frame serialization stage being operable to provide a sequenced data frame output;

a frame filter coupled to the frame serialization stage to receive the sequenced data

10   frame output and to provide a filtered data frame output; and

wherein, place holder frames are inserted in the sequenced data frame output for suspected omitted frames, and erasure frames are inserted in

15   the filtered data frame output for suspected bad data frames.

18.   The apparatus of claim 17, wherein the frame serialization stage is coupled to receive a next

20   expected sequence number.

19.   The apparatus of claim 17, wherein the frame serialization stage is coupled to an output of a frame CRC check stage and the frame filter is

25   coupled to an input of an RLP data layer.

METHOD AND APPARATUS FOR CHECKING COMMUNICATED DATA

Abstract of the Disclosure

An apparatus (18) and method (100) provide RLP

5 data checking. The apparatus (10) includes a frame

serialization stage (20) and a bad frame filter (22)

that detects possible bad frames and reclassifies

these bad frames as erasures. In this manner, bad

frame data are not passed to the RLP layer (16), and

10 unnecessary resetting and resynchronization steps

are avoided.

-15-

18

20

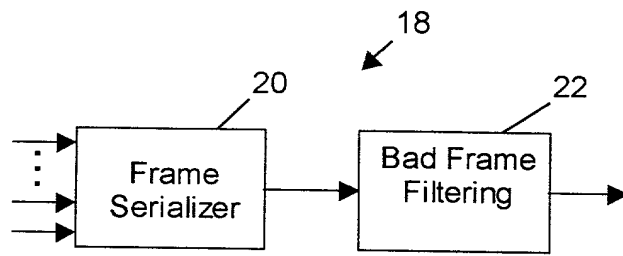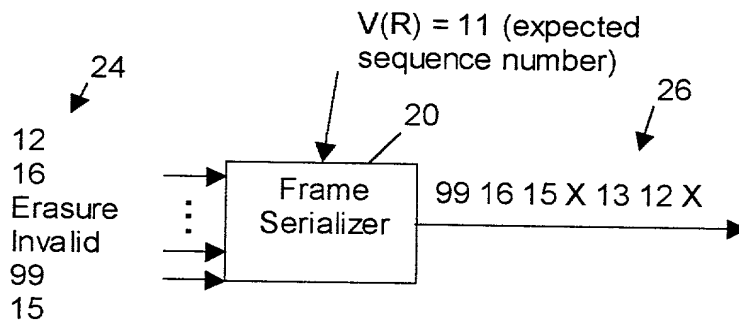Frame Serializer

22

Bad Frame Filtering

FIG. 2

V(R) = 11 (expected sequence number)

24

12
16
Erasure
Invalid
99
15

20

Frame Serializer

26

99 16 15 X 13 12 X

FIG. 3

10

12

symbol quality - %

14

CRC

16

RLP

PRE-RLP CHECK

18

FIG. 1

402 **Start** → 404 $C_i = 0$, for all i
$C_s = 0$

400

406 **Get Next Frame**
$i = $ rx channel

422 C_i++
C_s++

408 **New Data Frame?** — No

Yes

428 $C_i = 0$
$C_s = 0$
$V_s(R)$++

410 $C_i > T_i$? — No

Yes

412 **Extract RLP Sequence Number (SN)**

420 **Reclassify Frame as Erasure**

426 $V_s(R) = SN$

424 $C_n = 0$

414 $SN > V_s(R) + C_s + G_p$ — No

Yes

416 C_n++

418 $C_n > T_n$ — Yes / No

Measured Parameters

C_i – Consecutive Erasure/Invalid Count for channel i.
C_s – Consecutive Serial Erasure Counter
C_n – Consecutive Reclassified Frames
$V_s(R)$ – Next Expected SN for the serial frame stream.

Configurable Parameters

T_i – Number of consecutive frame erasures on channel i before allowing reclassification

T_n – Number of consecutively reclassified frames before updating the $V_s(R)$ estimate

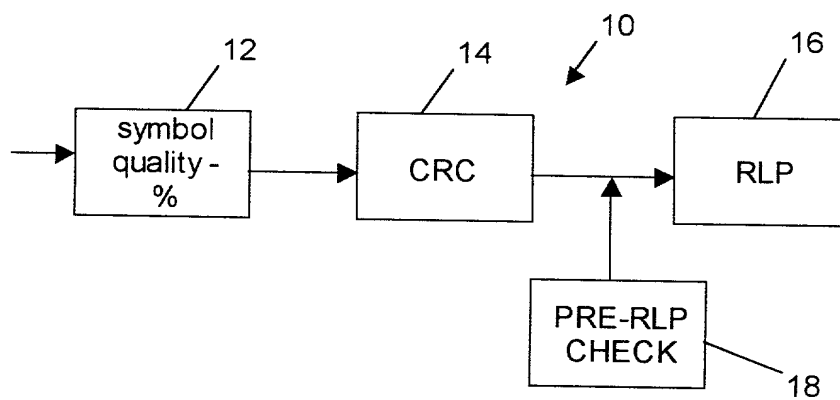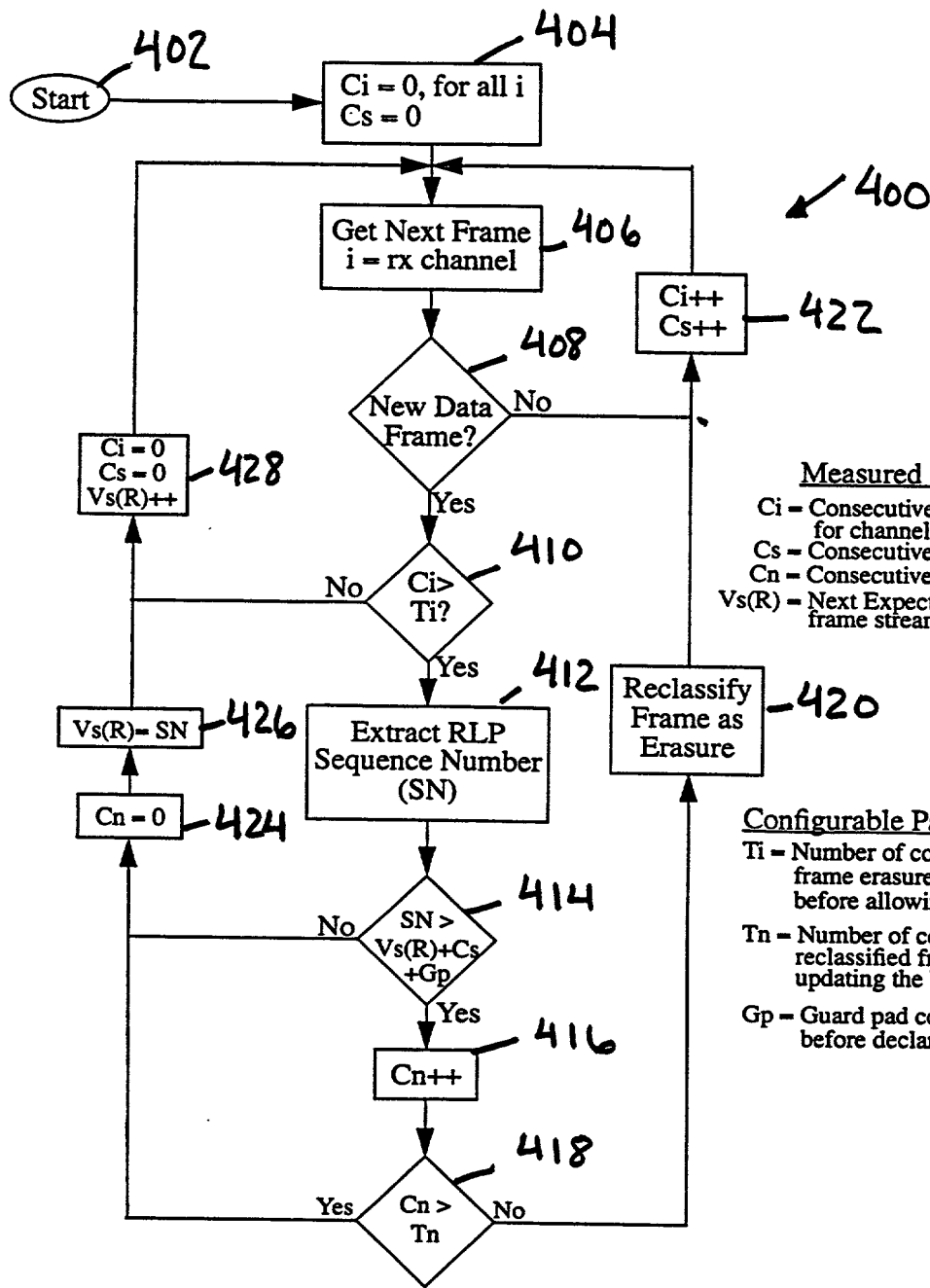G_p – Guard pad constant added before declaring reclassification

FIG. 4

PATENT APPLICATION DECLARATION COMBINED
WITH POWER OF ATTORNEY

__X__ REGULAR (UTILITY) OR ___ DESIGN APPLICATION
(check one)

Attorney Docket
No._____ CE08291R

As a below-named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name.

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled: Method and Apparatus for Checking Communicated Data the specification of which:

(check one)

  __X__ is attached hereto.

  ____ was filed on _____ as
    U.S. Application Serial No. _____
    and was amended on _____.
        (if applicable)

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to the examination of this application in accordance with Title 37, Code of Federal Regulations, Section 1.56(a).

I hereby claim foreign priority benefits under Title 35, United States Code, Section 119 of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed:

Prior Foreign Application(s):

(check one) __X__ no such applications filed.   Priority Claimed

      ____ such applications identified as follows:

(Serial No.)	(Country)	(Day/Month/Year Filed)	Yes	No
(Serial No.)	(Country)	(Day/Month/Year Filed)	Yes	No
(Serial No.)	(Country)	(Day/Month/Year Filed)	Yes	No

I hereby claim the priority benefit under Title 35, United States Code, Section 120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code, Section 112, I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations, Section 1.56(a) which is material to the examination of this application and which occurred between the filing date of the prior application and the national or PCT international filing date of this application:

- 1 -

Prior U.S. Applications(s):

(check
one)

     X   no such applications filed.

_____ such applications identified as follows:

_____   _____   _____
(Application Serial No.)   (Filing Date)   (Status) (Patented, Pending, Abandoned)

_____   _____   _____
(Application Serial No.)   (Filing Date)   (Status) (Patented, Pending, Abandoned)

_____   _____   _____
(Application Serial No.)   (Filing Date)   (Status) (Patented, Pending, Abandoned)

I hereby declare that: as to any claimed subject matter of this application which is common to my earlier United States or foreign application(s), if any, which I have identified above and claimed the benefit of priority thereof, I do not believe that the same was ever known or used in the United States before my invention thereof or patented or described in any printed publication in any country before my invention thereof or more than one year prior to the first of said earlier application(s), or in public use or on sale in the United States more than one year prior to the first of said earlier application(s), and that the said common subject matter has not been patented or made the subject of an inventor's certificate before the date of the first of said earlier U.S. application(s) in any country foreign to the United States on an application, filed by me or my legal representatives or assigns more than twelve months (six months if the present application is a Design patent application) prior to the first of said earlier U.S. application(s), if any; and that, as to any claimed subject matter of this application which is not common to said earlier application(s), if any, I do not know and do not believe that the same was ever known or used in the United States before my invention thereof or patented or described in any printed publication in any country before my invention thereof or more than one year prior to the date of this application, or in public use or on sale in the United States more than one year prior to the date of this application, and that said subject matter has not been patented or made the subject of an inventor's certificate in any country foreign to the United States on an application filed by me or my legal representatives or assigns more than twelve months (six months if the present application is a Design patent application) prior to the date of this application.

I HEREBY APPOINT THE FOLLOWING AS MY ATTORNEY(S) OR AGENT(S) WITH FULL POWER OF SUBSTITUTION TO PROSECUTE THIS APPLICATION AND TRANSACT ALL BUSINESS IN THE PATENT AND TRADEMARK OFFICE CONNECTED THEREWITH:

NAME(S)	REGISTRATION NO.(S)	ASSOCIATE POWER OF ATTORNEY ATTACHED
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Heather L. Creps	39,157	
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Sayed Hossain Beladi	42,311	

                                                      X
                                            _____   _____
                                            Yes   No

Send Written Correspondence To:
Intellectual Property Section – Law Department
MOTOROLA, INC.
1303 East Algonquin Road
Schaumburg, IL 60196
Direct Telephone Calls to: (847) 576-0379

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statement and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Full name of sole or
first inventor _____ Mark D. Hetherington _____

Inventor's signature _____

Date ___ 3 - 13 - 2000 _____

Residence _____ Crystal Lake _____ Illinois _____
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_____ Crystal Lake _____ Illinois _____ 60014 _____
        City   State or Country   Zip Code

Full name of
second inventor _____ Lee M. Proctor _____

Inventor's signature _____

Date _____ 3/3/00 _____

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Citizenship _____ U.S.A _____

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Full name of
third inventor _____ Nai Sum Wong _____

Inventor's signature _____

Date _____ 3/3/00 _____

Residence _____ Palatine _____ Illinois _____
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Citizenship _____ Hong Kong _____

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Full name of forth inventor	John M. Harris
Inventor's signature	
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